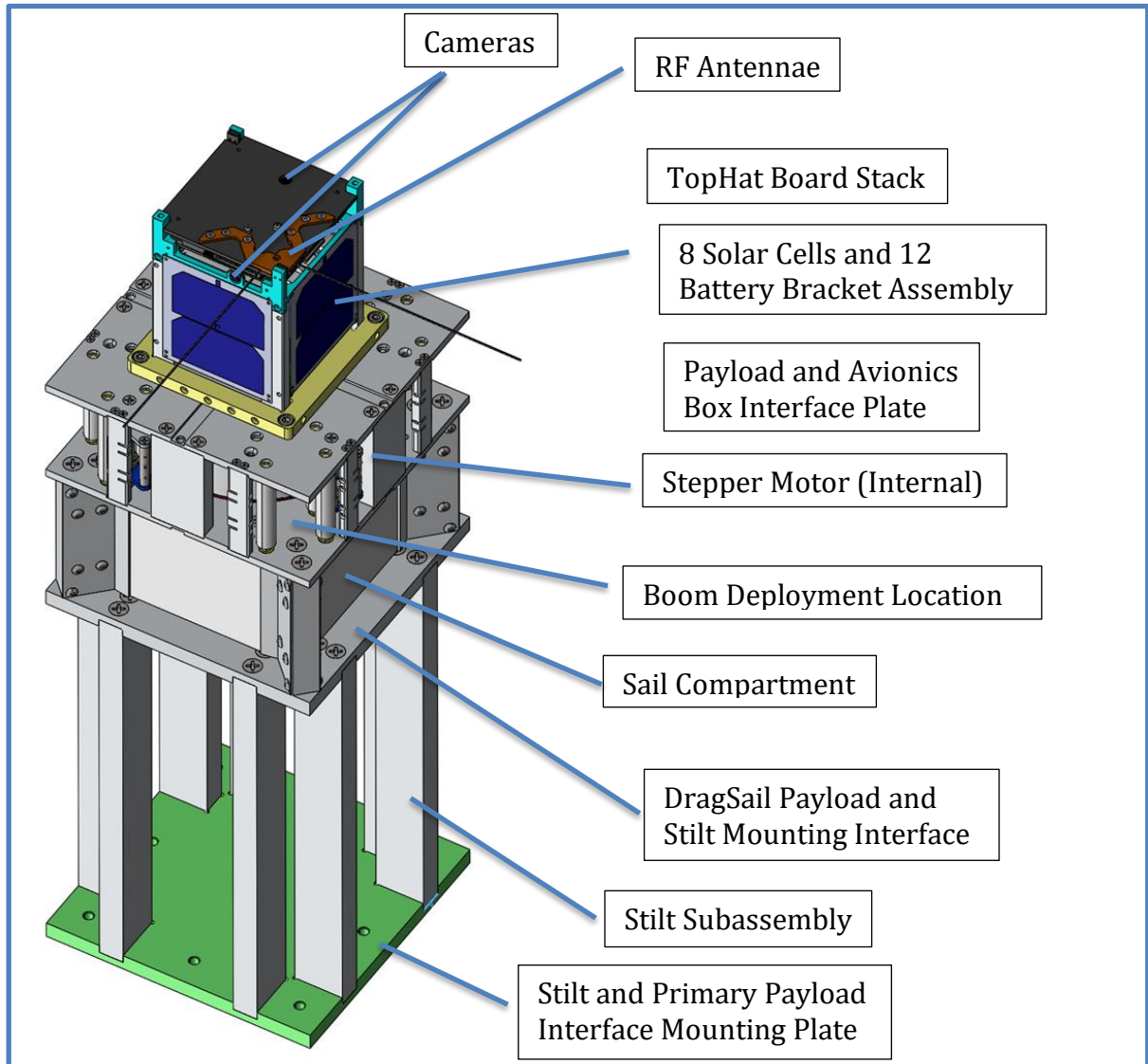


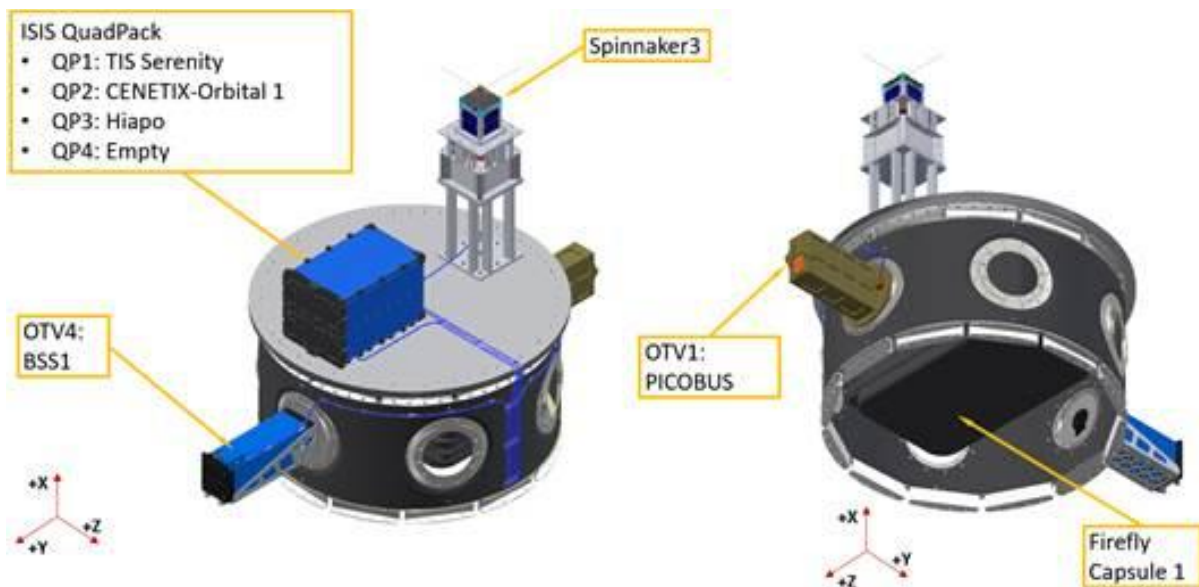
# Mission Description

Spinnaker3  
9U



### Brief Overview:

The Spinnaker3 payload is an 18 m<sup>2</sup> dragsail, sized to provide deorbit capability for the Firefly upper stage from altitudes of up to 650 km. The baseline orbital altitude for the Firefly upper stage on the FLTA001 launch is 300 km. The 9U (20 x 20 x 20 cm dragsail assembly and 10 x 10 x 10 cm avionics box) Spinnaker3 payload will be mounted on an interface plate, secured to the upper stage using the 15-inch (non-separating) Lightband standard interface.



Payload system startup will be initiated via a signal from the launch system of 3 – 5 amps for 150 – 500 ms. This signal is provided from the upper stage avionics just prior to the final upper stage passivation and power down operations. The upper stage avionics functions are fully autonomous with no ground command capability. The Spinnaker3 avionics are based on the PolySat standard spacecraft bus avionics. The PolySat flight software architecture is built around the Linux operating system, and operates on the flight-proven PolySat flight computer. A half-duplex, UHF band radio and a dipole antenna provides uplink and downlink capability at a frequency of approximately 437.15 MHz. A communications beacon will be transmitted at regular intervals, and file and image downlinks can be initiated via ground commands. An OmniVision OV3642 camera will be used to capture an image sequence of sail deployment. The camera will be configured to capture the dragsail and the Firefly upper stage in the field of view. The payload is powered by 12 Tenergy 18650 batteries (9V, 2200 mAh), sufficient to provide an operating lifetime of 35.28 hours with an average power utilization of 0.62 W while beaconing.

Dragsail deployment is initiated autonomously following system startup. A single stepper motor is used to control the deployment of four 3m SHEAth-based Rollable Lenticular

Shaped and low-Stiction (SHEERLESS) carbon fiber booms developed by NASA Langley Research Center. Four triangular sail segments will unfurl as the booms are deployed. The sail material is aluminized Mylar with a thickness of 5 microns. Deployment of the sail takes approximately four minutes.

Upper stage / Spinnaker3 payload tracking and mission operations will be conducted at Cal Poly, San Luis Obispo.

#### CONOPS:

Spinnaker3 shall power on via a 3-5 A for 150-500 ms signal at 28V from the launch vehicle interface cable with the Deployment Signal Board (DSB) within the avionics box after all other on-board CubeSats have deployed. The DragSail will deploy after receiving a ground command, or on a timer, within 48 hours after power-on; power-on is scheduled to occur 80 minutes after launch (T+4711 seconds). An issuable command shall be used as a fail-safe in case of a need for override. With successful deployment of the Spinnaker3 dragsail, the Alpha upper stage will deorbit in approximately 16 days (per Firefly GMAT analysis). Without successful deployment, Spinnaker3 will deorbit in approximately 24 days (per Firefly GMAT analysis). Hardware reboot will occur every 6 days, 1 hour, and 38 minutes on a timer. Photos shall be taken and transmitted along with IMU data throughout the duration of the mission. Operations shall cease between 16 days or 24 days depending on successful DragSail deployment.

#### Subsystems:

- Attitude Determination and Control System (ADCS)

Spinnaker3 will make use of an IMU composed of an accelerometer, magnetometers, and gyros. This will be used for angular acceleration data and to analyze the effects of the DragSail on the orbit of the satellite-second stage system.

- Command and Data Handling (C&DH)

Two RF antennae will transmit all data and receive all commands at 437.15Mhz.

- Communications

The Cal Poly Ground Station Network shall handle all two-way communications with Spinnaker3.

- Electrical Power System (EPS)

12 Tenergy Lithium Ion 18650 Cells

- Guidance Navigation and Control (GNC)

The de-orbit DragSail payload shall decrease the deorbit time of the satellite-second stage system.

- Imaging

One camera shall capture images of the sail to ensure correct deployment has occurred.